SINCLAIR ZX 8K ROM* UPGRADE

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* Use of the 8K operating system has been granted by Sinclair Research, thereby allowing this upgrade to be possible. I am grateful for their generosity.

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Dear Sinclair Enthusiast,

Here is the eprom upgrade for your operating system. Version 10. is the current issue. Several revisions have been made to both "fix" and improve the Sinclair BASIC operating system. I'm quite sure that all of the changes will delight you. You will probably forget that it is installed in a few short days. ALL of the software that would run before will still run, but you must have at least 16K RAM. The machine will initialize with 1 or 2K RAM, because of the partial decoding in the machine. Programs will not run though.

There are a few key changes that will remind you that you have indeed upgraded. The single most noticeable change is the automatic FAST edit. Now, whenever you enter an empty cursor, or key in a program line, the computer will jump into FAST mode and stay there until you input SLOW again. If your program requires SLOW mode to work properly, then remember to input SLOW in the direct mode before RUNning it. This alleviates that annoying "rolling screen" that can't decide which line should be listed first.

The second major change is the FAST initialization. Although the computer still only initializes 16K on power up, even a 64K NEW (POKE 16388,255 POKE 16389,255) will give a K cursor in the lower left corner in about 2 seconds. This routine will not adjust for your LACK of ram. If you only have 16K of ram, then don't poke ramtop up to 64K. I guarantee a crash. To run properly in 2K, POKE 16389,72 and NEW.

The Load routine has been changed slightly also. Before, if you had a bad load, the computer would jump into the middle of the initialization routine and reset the display file and stack pointers, but would leave clutter in memory (not really a problem) and not reset all of the operating system variables. Now, it jumps to the beginning of the NEW command and properly resets everything below RAMTOP. (RAMTOP is still a safe byte. NEW does not affect it.)

The CLS routine has been shortened and modified so as to not collapse the display file anymore. Before, everytime you enter a BASIC line the computer would check to see if you had enough memory to create a machine stack and steal memory from the display file if needed. Then, after computation, the display would have to be regenerated. As you pushed the limits of your memory, you stood a good chance of crashing because of all the stack manipulation. Now, the computer won't take a line unless it can handle it properly. As you approach the limit of your memory you will find that the computer will not take a line with a number, although it will take other lines. There just isn't enough room to compute those big floating point numbers. Try the following listing on a 2K machine to see what I mean:

In the direct mode, DIM A(10)

```
 1 REM
10 PRINT
20 PRINT 10
```

The problem of letting the display file overlap the 32K mark still exists, so if you have 64K beware! This problem exists because of the way that the Sinclair handles address line A15 (it is used as a sort of memory map line for the display). If you encroach on address 32768, you crash.

With a fixed size display file, another change is possible. SCROLL is now a very useful (and fast) routine. Before, if you scrolled your screen 22 times and then CLS, you could practically take a nap waiting to regain control of your Sinclair. Not anymore! Now, Flight Simulator acts properly after a crash (literally of course).

As a sideline to having a fixed display file, all those ROM checks to see if the display location is available fall through immediately, thereby slightly speeding up the print routines, such as, TAB and AT.

Do you use a large database? Now you can DIMension large single arrays up to 47872 (BB00h). If you have a monitor program in the 8-16K block and need no BASIC lines, then you can go just over 48000 (BBFFh) with your array. You can't make an array too large for your memory though. You will get a very thoughtful error 4.

Two bugs that have been squished (in the TS1500 also) are the LPRINT and divide bugs. The divide bug is a problem when doing repetitive math work, such as matrix inversion, simultaneous equations, TAN (the computer generates the TAN function by calculating SIN/COS), etc. If you do this type of work, you can notice a reduction in the sum of the squares calculations (see more info on this in SWN vol 1). For an interesting demonstration of this bug, run the short test listing before you put in the new eprom, and put the print line inside the loop (it won't run very long). This will answer the question; "how much is one bit?"

The other obvious bug is the LPRINT bug. This annoying creature sneaks up on you and prints garbage on your printer regardless of the interface or printer that you are using. This one got by Sinclair Research because there was no printer available when they finalized the last issue of the ROM. (Don't you just love aftermarket support!) The problem occurs when you try to print variable numbers less than 0.1 and greater than 1E-5. All of the leading zeroes come out as trash. To get around this problem you have had to convert your numbers to strings and LPRINT the strings. If you LET X = .0001, and then LPRINT X, you will see what I mean. This is no longer a problem.

A few cosmetic changes have made in the character generator also. Because the display on your TV is probably not the best in the world, we have changed some of the bit patterns in order to improve the readability of a few of the characters. The Q, W, V, K and British Pound sign have been modified. The most noticeable change is the pound sign, which is now an apostrophe. Now, the Q, O and 0 are all distinct; and the indeterminate W, U and V are well defined. They will all print that way on the 2040 and ZX printer too. Although the bit patterns are in the eprom, not all of the characters are available to change. If you look in the appendix of your instruction manual, only the first 64 characters are at your disposal (up to Z). The rest of the graphics, inverse characters, tokens and composite characters ("" and **) are created by the Sinclair logic chip and the token tables in the ROM. However, any of the first 64 characters can be changed (by further changing the eprom).

The last and most unique change that has been made to date is the modified LPRINT command. This command is transparent until you invoke it. This routine is called by RANDing an address in memory that you want to go to, POKE'ing 16393,1 (VERSN, which is the first byte saved in your program) and LPRINT'ing. For example:

```
10 RAND xxxxx (any address at which you have a working machine code
subroutine: end with RET)
20 POKE 16393,1 (or any odd number)
30 LPRINT (or LPRINT X, LPRINT "HELLO")
```

This is very similar to USR, except that LPRINT has syntax checking and has the power to easily pass variables or text to your routines without a lot of overhead or searching for your data. It can also act just like a USR call, except that you need not return a value, such as, LET X = USR nnnn.

To turn off this command, POKE 16393,0 (or any even number). In machine code use FD3509, which is DEC (IY+9). You can also use INC (IY+9) or RES 0, (IY+9). It's your choice. This byte is saved with your program and RAND USR calls could present a problem. It is a good idea to initialize this in a subroutine when you use it. Entering a program line will not invoke this command, however a direct command without a line number will, so take care.

I am in the process of writing a driver that will link (hopefully) relocatable subroutines together and actually extend the Sinclair Basic operating system. I will let you know when I have something worthwhile. I have a few things in mind, but I am open for both suggestions and submissions. Unfortunately, my duties at SyncWare News prevent me from spending all the time on this project that I would like to put in on it. I do hope that you enjoy it though.

INSTALLATION INSTRUCTIONS:

BEWARE OF STATIC ELECTRICITY

Turn your computer over and remove the 5 small screws holding it together. Remove the back and unscrew the 2 screws holding the PC board to the top half. Gently turn the PC board over exposing the chip side of the board. (Be careful with the keyboard connector. Don't kink it.) Locate the ROM. It is the one that is too small for its socket. Pry it up with a long thin screwdriver. Insert the eprom and its socket in the ROM's place. Make sure that all the socket pins are seated properly before you firmly press the sockets together. (If you break a pin, believe me, soldering those little jumper wires is a real bear!) Close up your case, run it and forget it!

The circuit will fit well in a TS1000, but may not fit in a ZX81 depending on how old it is (due to a redesign of the board). A single socket may be used, but this requires soldering on the eprom. The Eprom may also be used in a 1500, but it again requires soldering on the eprom. It has come to my attention that there are some TS1000's that have the ROM soldered in place. Don't worry. Just clip it out with some small wire cutters. Get one of those blue, suction type desolders (Radio Shack) and clean up the board. You can solder in the socket circuit or get a 28 pin low profile socket and solder it in. Plug in the EPROM and run it! If you have any questions or trouble, drop me a line or call me in the evenings at 301-730-7187.

ZX-81 EPROM UPGRADE CHANGES

```
 0000 D3FD          OUT FD,A
●0002 210080        LD HL,8000
●0005 C3C903        JP INIT
 0008 2A1640  ERRO  LD HL,(CHADD)
 000B 221840        LD (X PTR),HL
 000E 1846          JR ERRR
 0010 A7      INPR  AND A
 0011 C2F107        JP NZ PRCH
 0014 C3F507        JP PRSP


 034C 0E01    LDBY  LD C,01
 034E 0600    LNXB  LD B,00
 0350 3E7F    AGIN  LD A,7F
 0352 DBFE          IN A,FE
 0354 D3FF          OUT FF,A
 0356 1F            RRA
 0357 3049          JR NC LFAL
 0359 17            RLA
 035A 17            RLA
 035B 3828          JR C LBIT
 035D 10F1          DJNZ AGIN
 035F F1            POP AF
 0360 BA            CP D
●0361 3063    NOLD  JR NC BDLD
●0363 00            NOP
 0364 62            LD H,D
 0365 6B            LD L,E
 0366 CD4C03  NMIN  CALL LDBY


 03C3 CDE702  NEW   CALL TFAS
●03C6 2A0440  BDLD  LD HL,(RAMTP)
●03C9 54      INIT  LD D,H
●03CA 5D            LD E,L
●03CB 3E3F          LD A,3F
●03CD 2B            DEC HL
●03CE 3600    CLER  LD (HL),00
●03D0 2B      16K-  DEC HL
●03D1 BC            CP H
●03D2 20FA          JR NZ CLER
●03D4 EB            EX DE,HL
●03D5 1810          JR MORE
●03D7 CDA60D  LINE  CALL FL37
●03DA 2804    CHEK  JR Z NOST
●03DC FDCB0946 FLAG BIT 0,(VERSN)
●03E0 CACB0A  NOST  JP Z LPRN
●03E3 2A3240  VEST  LD HL,(SEED)
●03E6 E9      JUMP  JP (HL)
 03E7 220440  MORE  LD (RAMTP),HL
 03EA 2B      INIT  DEC HL
 03EB 363E          LD (HL),3E
 03ED 2B            DEC HL
 03EE F9            LD SP,HL
 03EF 2B            DEC HL
 03F0 2B            DEC HL
 03F1 220240        LD (ERRSP),HL
 03F4 3E1E          LD A,1E
 03F6 ED47          LD I,A
 03F8 ED56          IM 1
 03FA FD210040      LD IY,ERRNR
 03FE FD363B40      LD (CDFLG),40
 0402 217D40        LD HL,407D
 0405 220C40        LD (DFILE),HL
 0408 0619    LILO  LD B,19
●040A CD570A        CALL MAKE
 040D 221040        LD (VARS),HL
 0410 CD9A14        CALL CLER
 0413 CDAD14  BASI  CALL K-EL
●0416 CD230F        CALL FAST
 0419 CD2A0A  UPPR  CALL CLS
 041C 2A0A40        LD HL,(E PPC)
 041F ED5B2340      LD DE,(S TOP)
 0423 A7            AND A
 0424 ED52          SBC HL,DE
```

;0002 Reflects a preset Ramtop (a la 1500)
;0005 Jump to the proper INIT point

Version 10. Thomas Bent

;0361 This change changes where you go in case of a BaD LoaD. This location was changed primarily to make more consecutive space in the INIT routine. However, it does make this routine function properly.
;0363 This NOP clears the garbage left by the change from the 3 byte (jump) to the 2 byte (jump relative) command

;03C3 This INIT routine is completely re-written in order to both speed up and add other changes. BC is no longer used and therefore contains 0000 when not in use (instead of a number near ramtop).

; The memory check is no longer present, so you must have at least 16K in order to function properly. A 2K machine will initialize and take BASIC commands, but as soon as you over-write your phantom stack pointer, good-by. (This is due to partial decoding and repeating of memory segments in a 2K machine.)

;03D7 This is the new location of LPRINT. First you check to see if Syntax is being tested, by checking BIT 7 of Flags. If you are entering a line, then you go to the regular LPRINT routine. If you enter a direct command or are running a program, then you test BIT 0 of VERSN. If it is 0 then you again jump to the LPRINT routine. If it is 1, then you get the number set by RAND and jump to that location. There is no commercial software other than the AERCO printer interface that uses this byte (VERSN) That I know of. They do not use BIT 0 though.

;040A Make the display. This routine was relocated in order to make more space above.

;0416 This one byte change serves a double purpose. It completes initialization in fast mode, and everytime you key in an empty cursor or enter a line you come back in FAST mode.

```
0A2A 0618       CLS   LD B,18
0A2C FDCB018E   CLLN  RES 1,(FLAGS)
0A30 0E21             LD C,21
0A32 C5               PUSH BC
0A33 CD1809     FULL  CALL 09EDF
0A36 C1         DIS-  POP BC
0A37 FDCB3AFE   PLAY  SET 7,(SPOSL)
0A38 AF               XOR A
0A3C CDF507           CALL PRSP
0A3F 2A3940           LD HL,(SPOSN)
0A42 7D               LD A,L
0A43 84               OR H
0A44 E67E             AND 7E
0A46 20F3             JR NZ 0A3B
0A48 C31809     DONE  JP 09EDF
0A4B 0620       SCRL  LD B,20
0A4D AF         PT2-  XOR A
0A4E 2B               DEC HL
0A4F 77               LD (HL),A
0A50 10FC             DJNZ 0A4E
0A52 012103           LD BC,0321
0A55 18F1             JR DONE
0A57 3676       MAKE  LD (HL),76
0A59 23         DIS-  INC HL
0A5A 10FB       PLAY  DJNZ MAKE
0A5C C9               RET
0A5D CD170A     MCLE  CALL RSUB
0A60 C5         MMCL  PUSH BC
0A61 78               LD A,B
0A62 2F               CPL
0A63 47               LD B,A
0A64 79               LD A,C
0A65 2F               CPL
0A66 4F               LD C,A
0A67 03               INC BC
0A68 CDAD09           CALL ADPT
0A6B EB               EX DE,HL
0A6C E1               POP HL
0A6D 19               ADD HL,DE
0A6E D5               PUSH DE
0A6F EDB0             LDIR
0A71 E1               POP HL
0A72 C9               RET
0A73 2A1440     ELNR  LD HL,(ELINE)
```

;0A2A The CLS routine has been truncated to make more space for the SCROLL routine. It no longer collapses the display for any reason. Throughout each of the display and pointer setting routines, there are tests to see if room is available. Since there always is, all of the tests fall through and the machine runs slightly (though not noticeably) faster.

;0A4B This is the last part of the SCROLL routine. It does what the old routine did not. It pads out the line with blanks.

;0A52 This value sets the print position to the lower left the same as "PRINT AT 21,0;" (LD BC 2100 and jump to the print at routine), but since the print at routine leaves 0321 in BC, why not bypass it and speed up the routine that much more.

;0A57 This is the create an empty screen routine. It was put here to make space elsewhere. It is only called from NEW. After the first CLS command (which is always done in FAST mode now), you then have a full display file and it stays that way.

```
0C0E 2A0C40     SCRL  LD HL,(DFILE)
0C11 23               INC HL
0C12 E5               PUSH HL
0C13 112100           LD DE,0021
0C16 19               ADD HL,DE
0C17 D1               POP DE
0C18 0617             LD B,17
0C1A C5               PUSH BC
0C1B 012000           LD BC,CHAD
0C1E EDB0             LDIR
0C20 13               INC DE
0C21 23               INC HL
0C22 C1               POP BC
0C23 10F5             DJNZ 0C1A
0C25 2B               DEC HL
0C26 C3480A           JP SCL2
0C29 8B         OFFT  ADC A,E
0C2A 8D               ADC A,L
0C2B 2D               DEC L
0C2C 7F               LD A,A
0C2D 81               ADD A,C
0C2E 49               LD C,C
0C2F 0F               RRCA
0C30 00               NOP
0C31 23               INC HL
0C32 0F               RRCA
0C33 00               NOP
0C34 69               LD L,C
0C35 08               EX AF,AF'
0C36 05               DEC B
0C37 D7         +NEW  RST 10H
0C38 03         SPOT  INC BC
0C39 03               INC BC
```

;0C0E The SCROLL command is completely different, and in fact much faster than the old one. It is a modification of a program by Dan Tandberg, called Fast Scrolling (a collection of which is by the way, available in a listing from T. Woods). It is quite good.

;0C29 This is the beginning of the offset table. All of the BASIC command addresses are located in this table. If you relocate (permanently) a given BASIC command, then just put the starting address in the slot designated for the command that you change. That is precisely what we have done with LPRINT. The address 03D7 corresponds to the new routine address. We take over before any flags have been set or variables changed, AND more importantly, we do not touch the old routine at all.

```
 1409 CD1C11    DIM   CALL LUVA
 140C C29A0D    DCER  JP NZ CERR
 140F CDA60D          CALL FL57
 1412 2008            JR NZ DRUN
 1414 CBB1            RES 6,C
 1416 CDA711          CALL STVA
 1419 CD1D0D          CALL CSEV
 141C 3808      DRUN  JR C DLTR
 141E C5              PUSH BC
 141F CDF209          CALL NXBV
 1422 CD600A          CALL MMCL
 1425 C1              POP BC
 1426 CBF9      DLTR  SET 7,C
 1428 0600            LD B,00
 142A C5              PUSH BC
 142B 210100          LD HL,0001
 142E CB71            BIT 6,C
 1430 2002            JR NZ DNUM
 1432 2E05            LD L,05
 1434 EB        DNUM  EX DE,HL
 1435 E7        DMLD  RST 20H
●1436 26BB      DM48  LD H,BB
 1438 CDDD12          CALL INBC
 143B DA3112          JP C 3ERR
```

;1436 This is one of those oversight routines that is useless. Sinclair must have thought that no one would ever use the ZX81 with more than 16K. He put an arbitrary limit on the size of a single array at 16K. I changed this LD H,40 to LD H,BB, but it may as well been FF. You can't make an array larger than memory available anyway. Other routines watch out for this error. This routine could be eliminated and something else put in that is more useful. There is at least 8 bytes here.

```
 16B8 3E1C      ZSTR  LD A,1C
 16BA D7              RST 10H
●16BB 10FB            DJNZ ZSTR
 16BD 1809            JR PRTM
 16BF 3E1C      ZEXP  LD A,1C
 16C1 D7              RST 10H
 16C2 35        TINT  DEC (HL)
 16C3 34              INC (HL)
 16C4 E8              RET PE
 16C5 3E1B            LD A,1B
 16C7 D7              RST 10H
 16C8 35        PRTM  DEC (HL)
 16C9 34              INC (HL)
 16CA E8              RET PE
 16CB CDD016          CALL PDGT
 16CE 18F8            JR PRTM
 16D0 7E        PDGT  LD A,(HL)
 16D1 E60F            AND 0F
 16D3 CDEB07          CALL PRCD
 16D6 2B              DEC HL
 16D7 C9              RET
 16D8 7E        PADD  LD A,(HL)
```

;16BB This oversight originally jumped back only to 16BA and printed whatever was in A (garbage). This change was originally reported in Syntax, and this change has been incorporated in the 1500 ROM.

For more information on the Sinclair ROM, I suggest purchasing Ian Logan's ZX81 ROM Disassembly part A and B. For easy study, enjoyment and other Sinclair related pleasures, I suggest purchase of Hot Z II (although I still prefer Hot Z I) and get the ROM name file. This listing is done with this name file in memory and as you can see, it makes it quite easy to see what is going on (especially with a hardcopy listing and explanation in front of you). It is available from Tom Woods.

```
 18AB 29        DV3B  ADD HL,HL
 18AC D9              EXX
 18AD ED6A            ADC HL,HL
 18AF D9              EXX
 18B0 3810            JR C NCRE
 18B2 ED52            SBC HL,DE
 18B4 D9              EXX
 18B5 ED52            SBC HL,DE
 18B7 D9              EXX
 18B8 300F            JR NC DGCS
 18BA 19              ADD HL,DE
 18BB D9              EXX
 18BC ED5A            ADC HL,DE
 18BE D9              EXX
 18BF A7              AND A
 18C0 1808            JR DCOU
 18C2 A7        NCRE  AND A
 18C3 ED52            SBC HL,DE
 18C5 D9              EXX
 18C6 ED52            SBC HL,DE
 18C8 D9              EXX
 18C9 37        DGCS  SCF
 18CA 04        DCOU  INC B
 18CB FAA218          JP M DVLO
 18CE F5              PUSH AF
●18CF 28DA            JR Z DV3B
 18D1 5F              LD E,A
 18D2 51              LD D,C
```

☐ The other changes are all in the bit patterns
☐ of the letters. For more details on how to
☐ change bit patterns, I direct you to SyncWare
☐ News, Issue 2/2, and John Oliger's, Video
☐ Upgrade ROM changes article.

;18CF This jump originally jumped back to 18BA instead of 18AB. Somebody must have written this routine on overtime, but it is an easy oversight indeed. This is also fixed on the 1500.

```
TRY THIS. SHOW IT TO YOUR TS
FRIENDS.
QQQ VVV WWWW UU OO KKK ''''

ALSO TRY POKE 16389,255 ENTER
NEW
DIM A$(45000)
LET A$(45000)=1
PRINT A$(45000)
YOU ARE READY FOR A BIG ZX/PRO-
FILE NOW
1
0.1
.01
.001
.0001
.00001
1E-6
1E-7
1E-8
1E-9
  10 LPRINT ,,,,"TRY THIS. SHOW
IT TO YOUR TS    FRIENDS."
  12 SLOW
  14 LPRINT "QQQ VVV WWWW UU OO
KKK ''''",,,"ALSO TRY POKE 16389
,255 ENTER   NEW",,"DIM A$(45000
)"
  15 LPRINT "LET A$(45000)=1  ",
"PRINT A$(45000)"
  16 LPRINT "YOU ARE READY FOR A
 BIG ZX/PRO- FILE NOW"
  19 LET X=10
  20 FOR I=1 TO 10
  30 LET X=X/10
  40 PRINT X
  50 LPRINT X
  60 NEXT I
  69 PRINT " INPUT ANY KEY"
  70 PAUSE 4E4
  80 CLS
  90 FOR J=1 TO 10
 100 FOR I=1 TO 22
 110 PRINT "XXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXX"
 120 NEXT I
 130 FOR I=1 TO 22
 140 SCROLL
 150 PRINT "Y"
 160 NEXT I
 170 CLS
 180 NEXT J
 200 LLIST 10
```

```
10 LET X=TAN (PI/4)-1
30 FOR I=1 TO 1000
40 LET X=X+X
60 NEXT I
70 PRINT X
90 PRINT I
```

HARDWARE PROJECTS

Run TS1000 Machine Code in High Memory

John Oliger

ZX81ers don't despair! This next trick was originally published in Syntax Quarterly, Summer 1983. It will allow you to use the 32-48K RAM area for machine code, if you have the Memotech or JLO 64K boards (and maybe some others, but not the Byte-Back UM).

It is necessary to add a little extra circuitry to separate out the video system from the dynamic RAM system, as Sinclair never dreamed of a ZX81 with more than 16K. Very simply, you cut the M1 not trace between the Z80 (pin 27) and the ULA (pin 10). Connect pin 2 to the Z80 side and the output on pin 8 to the ULA side. Again, use an ohm meter to chase down the A14, A15, Vcc (5 volts) and ground lines. They can all be picked up at or near the edge connector (except pin 8), but you may find some more convenient places. The diagrams show some very good places to pick up these traces. Be sure to remove all ICs (if possible) before doing any soldering.

Any relocatable programs will run here and not be affected by NEW or reset. ZXLR-8, Delphic toolkit, compiled programs with the Bob Berch Compiler, Hot Z and an assortment of other utilities will work up there and NOT interfere with any 16K program on the market.

Additional Byte-Back Memory Pack Notes:

Jeffrey D. Moore
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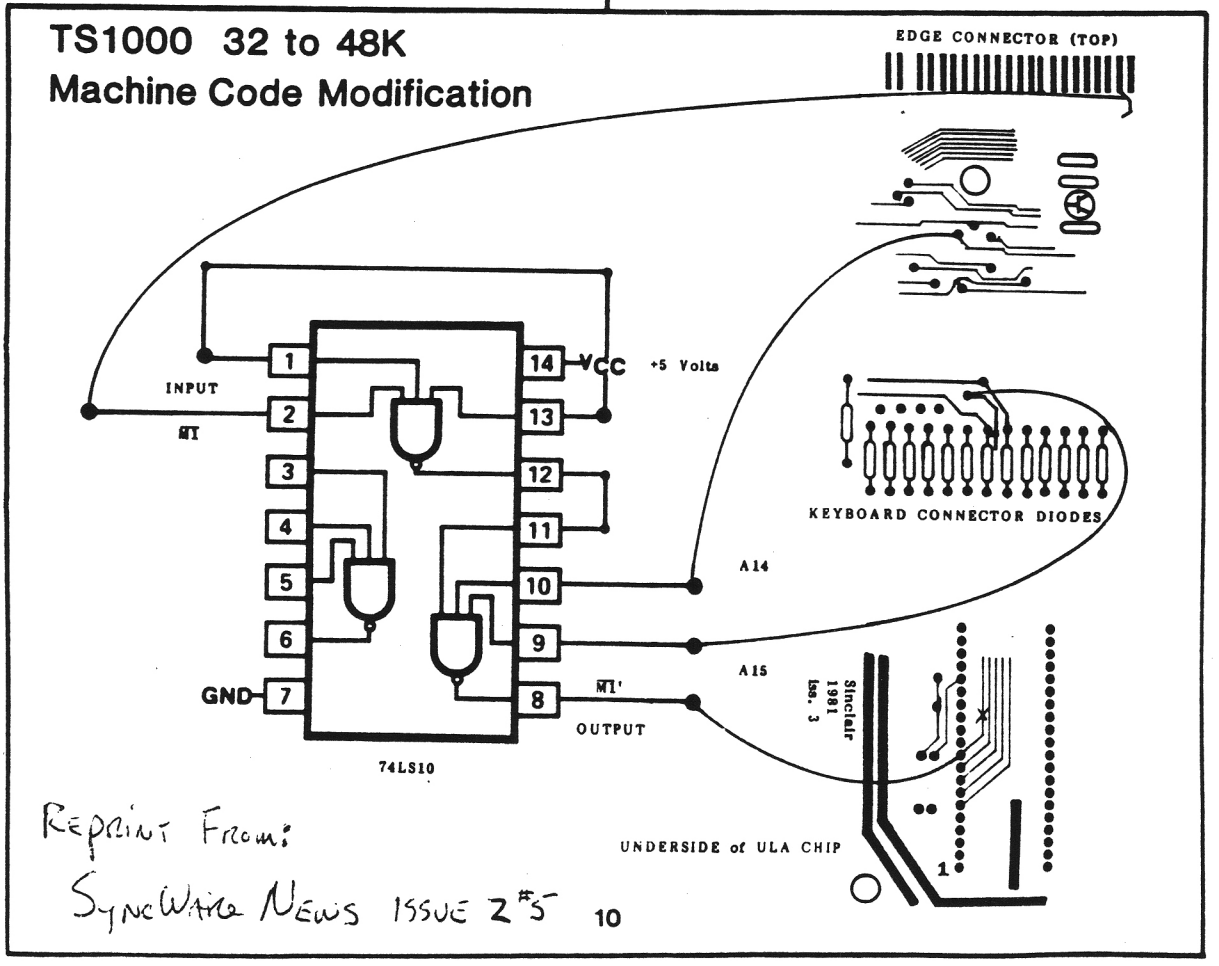
Louisville, Ohio 44641

Thanks to John Oliger's NOT M1 decoding circuit, many new and excellent pieces of software are coming into the market place that make use of machine language routines in the 32K-48K (8000-BFFF hex) region of memory. Some examples of these would include Hot Z-II by Ray Kingsley and Memotext in RAM, Version 3, modified and marketed by Fred Nachbaur.

However, there is one catch! It is best summed up by Ray Kingsley in his Hot Z-II User's Notes. "If you have a suitable memory...Oliger or Memotech or possibly another: Not a Byte-Back M-64 (or UM-64K memory-JM)...and you make the Oliger modification to your computer, you can run machine code in the 32K-48K block...".

I contacted Mr. Oliger, and he sadly confirmed that it was true, a Byte-Back M-64 or a UM-64K memory would not work with the NOT M1 decoding circuit. However, our conversation, and subsequent correspondence, led Mr. Oliger to develop the two chip



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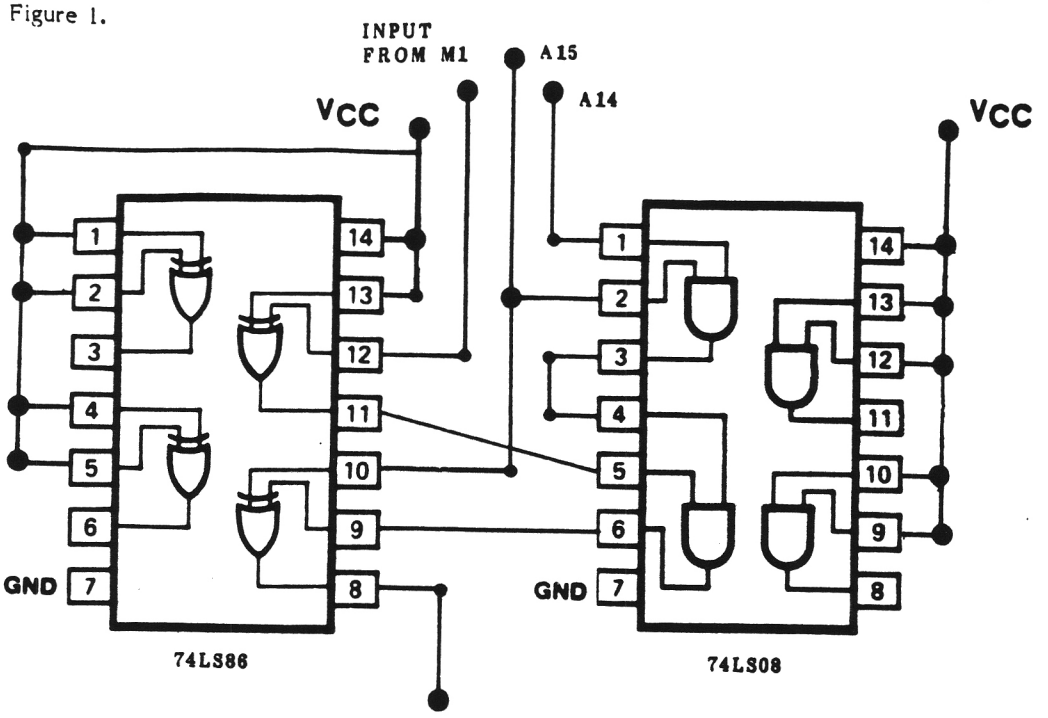
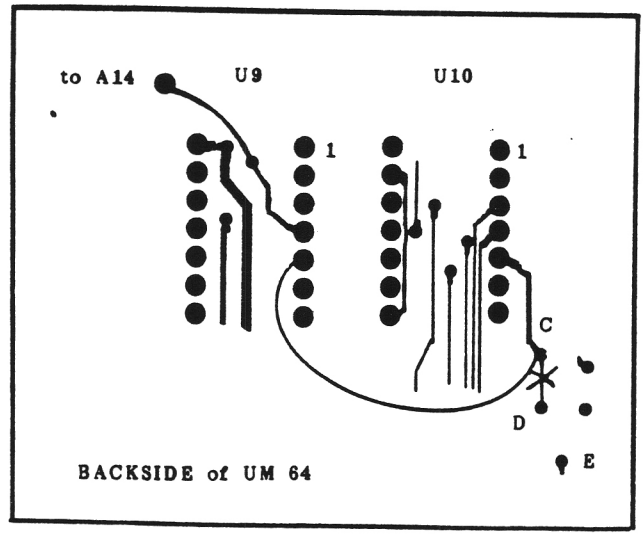
MODIFICATION for the BYTE BACK UM-64 RAM PACK

Figure 1.



buffer circuit shown in figure 1. I implemented and tested it in the Byte-Back M-64 Memory Pack, and found that it works great!

The buffer circuit itself should be constructed on a small universal circuit board (Radio Shack 276-150, or equiv., works well). Mount the buffer circuit on the heat sink side of the M-64/UM-64K memory circuit board with double-faced foam tape after all the wiring and inter-connections are complete. Care MUST be taken to fully electrically insulate the small board from the main board.



M-64 Hook-up

Modification of the M-64K memory board requires that two circuit traces be cut and seven wires installed to add the new circuit to the existing memory circuit. Find the 74LS08 (U12) chip on the M-64K memory board. Locate the circuit trace going from a feed-thru hole to pin 6 of this IC. Cut the trace between the feed-thru hole and pin 6 of U12. On the heat sink side of the M-64K memory board, locate the circuit trace going to pin 4 of the 74LS32 IC (U11) and cut it at a convenient place. Using the plated feed-thru holes on the M-64K memory board where possible as solder points (not necessary, but it makes for a neater job), make the following connections:

1) Connect Vcc of the buffer board to the hole for pin 16 of the spare chip on the M-64K memory board.

2) Connect GND (ground) of the buffer board to the hole for pin 8 of the spare chip on the M-64K memory board.

3) Connect A15 of the buffer board (74LS08 pin 2 and 74LS86 pin 10) to pin 5 of the 74LS08 (U12) on the M-64K memory board.

4) Install a jumper on the M-64K memory board from pin 5 of the 74LS08 (U12) to pin 4 of the 74LS32 (U11).

5) Connect A14 of the buffer board (74LS08 pin 1) to pin 5 of the 74LS32 (U11) on the M-64K memory board.

6) Connect NOT M1 of the buffer board (74LS86 pin 12) to pin 4 of the 74LS08 (U12) on the M-64K memory board.

7) Finally, connect the output of the buffer board (74LS86 pin 8) to pin 2 of the 74LS244 IC chip (U16) closest to the 74LS08 chip (U12) on the M-64K memory board.

UM-64 Connections

On the UM-64K memory board, one jumper needs to be removed, one trace needs to be cut, and seven wires must be connected. [Note: If you install the decoder board on the back of the UM-64 board, you may not have room for the backup battery. If this is important, consider mounting the decoding chips upside-down on one of the RAM IC's on the front side with crazy glue. Run "flying leads" to the appropriate circuit points. -ed.]

1) Remove the jumper (trace cut) going from "C" to "D".

2) Locate the circuit trace going to pin 2 of the 74LS244 IC (U16) closest to the EPROM socket and cut the trace in a convenient location, as close to pin 2 as possible.

Using feed-thru holes where available, make the following connections:

3) Connect +Vcc on the buffer board to +5 volts on the UM-64K memory board at a convenient location.

4) Connect GND of the buffer board to GND on the UM-64K memory board at a convenient location.

5) Connect A15 of the buffer board (74LS86 pin 10 and 74LS08 pin 2) to pin 5 of 74LS08 (U10) of the UM-64K memory board.

6) Install a jumper on the UM-64K memory board from pin 5 of the 74LS08 (U10) to "C" (A15 needs to be connected to pin 5 of U9, through "C" is the easiest way to get there).

7) Connect A14 of the buffer board (74LS08 pin 1) to pin 4 of the 74LS32 (U9) of the UM-64K memory board.

8) Connect NOT M1 of the buffer board (74LS86 pin 12) to pin 4 of the 74LS08 (U10) of the UM-64K memory board.

9) Finally, connect the output of the buffer board (74LS86 pin 8) to pin 2 of the 74LS244 chip (U16) closest to the PROM socket on the UM-64K memory board.

Be sure to double check all of your connections to insure that they are correct and that you have not created any solder bridges. Make sure the buffer board is secure to the M-64K memory board and that they are insulated from each other.

If you haven't already done so, make the modifications to your computer for NOT M1 Decoding per John Oliger's article and test that circuit. When all is well, power down your computer and connect the modified M-64K/UM-64K Memory Pack to it. Power back up. If that old familiar little "K" cursor shows up on the screen, you're over half way home. If not, immediately power down and re-check the buffer circuit and its connections for shorts and improper wiring. When everything checks out and powers up O.K. with the modified memory pack connected, enter the following commands: POKE 40000,201 followed by PRINT USR 40000. The screen should return 40000. This is a fair indication that everything is pretty much as it should be, but it is not foolproof. The "acid" test is to now load or write a program that runs MC in the 32K-48K region of memory and try it. It should now run correctly without any problems.